Title: Study of proper and improper microwave dielectric losses by means of teraherz and infrared spectroscopy

Author: Ondřej Tkáč

Department: Department of Dielectrics, Institute of Physics, Academy of Sciences of Czech Republic

Supervisor: RNDr. Stanislav Kamba,CSc., Na Slovance 2, Prague 8

Supervisor's e-mail adress: kamba@fzu.cz

Abstract: In the first part of this thesis there is described relevant theory, especially we pay our attention to the principles of infrared spectroscopy and fitting models, then to the explanation of the terms proper and improper dielectric losses and we also discuss dielectrics and ferroelectrics. By means of Fourier transform infrared spectroscopy we measured infrared spectra at room temperature in the range of 30 - 3000 cm^{-1}. We fitted the spectra and then we extrapolated the final complex permitivity into the microwave range. This enabled us to estimate the proportion of improper dielectric losses on total microwave losses. By the ceramic $Sr_{9-x}Pb_xCe_2Ti_{12}O_{36}$ (x =0 to 9) we studied the impact of amount of lead on dielectric properties. We found out that the substitution of strontium with lead causes the increase of permitivity up to several thousands and forces ferroelectric transition for x>2. With perovskite $CaZn_{1/3}Nb_{2/3-x}V_xO_3$ (x=0 to 0,01) we examined the influence of the vanadium content on dielectric properties, especially on temperature coefficient of resonance frequency τ_f. Further, we studied the influence of substitution on dielektric properties of pyrochlore $Bi_{1.5}Zn_{1-x}M_xNb_{1.5}O_{7-x}F_{xx}$ (M=Li^{1+}, Ca^{2+}, Zn^{2+}). Finally we dealed with the ceramic $BiSbO_4$, where we measured negligible improper losses. All of our results will be used for improving of ceramic preparation methods in order to minimalize improper dielectric losses.

Keywords: proper and improper dielectric losses, infrared spectroscopy, ferroelectrics